Multi-class computer-aided diagnosis for prostate cancer mapping

Internship proposal

Scientific context Computer aided detection (CAD) systems are designed to assist clinicians in their diagnosis by highlighting abnormal regions in an image. One way of doing so consists in performing a classification at the voxel level where the decision model is learned on a series of feature vectors selected from normal and pathological locations on patient scans. This internship focuses on developing a new computer-aided diagnosis system for prostate cancer screening based on multiparametric magnetic resonance imaging. This CAD system will address a complex and challenging problem of prostate cancer mapping where the goal is to predict not only a presence/absence of cancer but also the degree of its aggressiveness. From the methodological point of view, we plan to approach it by introducing new machine learning algorithms that tackle the problem induced by the presence of highly correlated and interdependent outcomes in multi-class classification. A main assumption of this project is that multi-class classification can be efficiently reduced to a set of binary classification problems for each possible class and further considered as a set of tasks in the multitask learning where the interdependency and high classes confusability are appropriately addressed through adding new appropriate terms to the optimized objective function. The expected benefits of this idea lie in the proper mathematical modelling of the above mentioned phenomena and in the natural capacity of multitask learning to: (1) model the task relatedness that will allow to benefit from information provided by highly correlated and potentially interdependent classes and (2) operate on partially labeled data.

Objectives The main goal of this internship is to perform an empirical study regarding the usefulness of multitask learning in handling classification tasks with multiple classes that can be interconnected. This study will be performed on the real-world data set consisting of a collection of annotated MRI images of prostates.

Keywords Prostate cancer mapping, machine learning, biomedical imaging, multi-task learning, multi-class classification.

Skills Strong knowledge in at least one of the following fields is required:

- Image processing;
- Statistical learning (machine learning);
- Applied mathematics;
- Statistics.

The available code is written in Matlab and Python but other languages can be used. The successful candidate is expected to be autonomous and show strong motivation and interest in multidisciplinary research (image processing and machine learning in a medical context).

Applications Interested applicants are required to send a cover letter, CV and any other relevant documents (reference letter, recent transcripts of marks,...) to:
carole.lartizien@creatis.insa-lyon.fr and ievgen.redko@creatis.insa-lyon.fr.

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